Sparx 5: Linear Graphs & Real life graphs - Red indicates

Shaw Education Trust | The Ormiston Academy

Knowledge Organiser - Mathematics

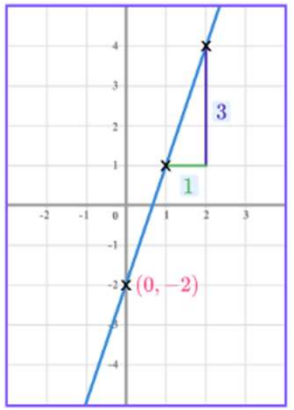
Equation of a Straight Line

The general equation of any straight line is:

$$y = mx + c$$

c is the y-**intercept** (where the line crosses the y-axis)

m is the **gradient** (steepness) of the line



Example: The graph of the line $y = 3x - 2$

The gradient is 3

The y-intercept is -2, the coordinate $(0, -2)$

Parallel Lines

Example: *Find the equation of a line parallel to 2x + y = 4, that crosses the y-axis at 3.*

1. *Rearrange the equation in the form y = mx + c*
   y = 2x + 4

2. *Identify the gradient*, in this case 2

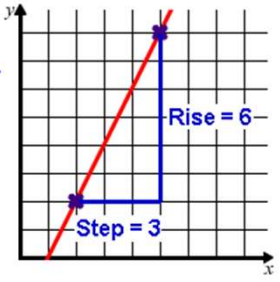
Any line with the same gradient is parallel

3. *Write c as the y-intercept.*
The line that has the same gradient and has a y-intercept of 3 is y = 2x - 3

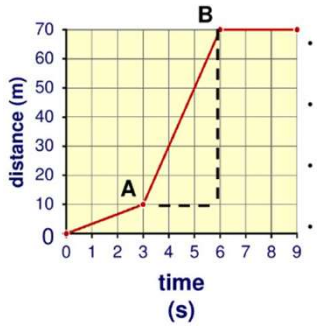
Gradient

Calculated as difference along the y-axis divided by

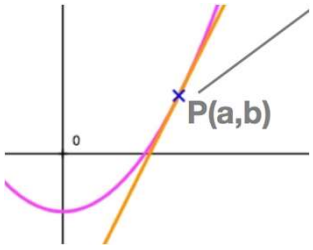
$$\text{Gradient} = \frac{\text{Rise}}{\text{Step}} = \frac{6}{3} = 2$$



The gradient on a distance-time graph represents speed, since speed is the compound measure derived from distance divided by time.



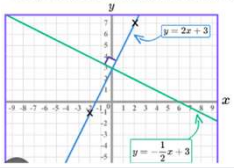
- Gradient = $\frac{\text{Change in distance}}{\text{Change in time}}$
- Gradient = $\frac{\text{Distance at B – Distance at A}}{\text{Time at B – Time at A}}$
- Gradient = $\frac{70\text{m} - 10\text{m}}{6 - 3} = \frac{60\text{m}}{3}$
- Gradient = 20m/s



The tangent to the curve at P has the same gradient as the curve at that point.

Perpendicular Lines

Perpendicular lines have gradients that multiply to give -1.
The gradients of perpendicular lines are the **negative reciprocals** of each other.



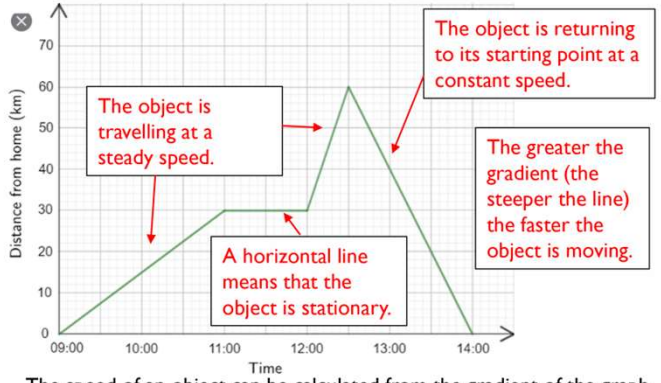
Example

The line $y = 2x + 3$ has a gradient of 2

The line $y = -\frac{1}{2}x + 3$ has a gradient of $-\frac{1}{2}$

$2 \times -\frac{1}{2} = \frac{-2}{2} = -1$ (The gradients multiply to give -1)

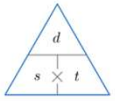
Distance time graphs



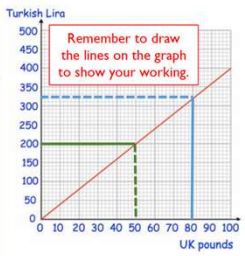
The speed of an object can be calculated from the gradient of the graph.

E.g. calculate the speed at which the object travelled between 9am and 11am.

Speed = 30 ÷ 2
= 15 km/hr



Conversion graphs



Change £80 into Turkish lira

1) Start at 80 on the horizontal axes as this for pounds and go up vertically until you reach the line
2) From the line, read horizontally until you get to the axis showing lira

Change 600 Turkish lira to pounds

As this value is not shown by the graph, we have to use a value that is to help.

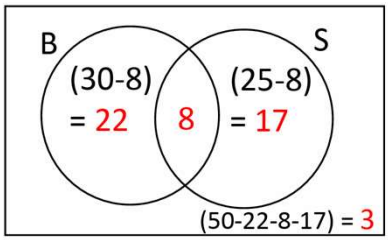
1) Start at 200 on the vertical axes and go across horizontally until you reach the line. From the line, read vertically until you get to the axes.
2) 200 lira = £50
   600 lira = £150

Sparx 6: Venn & Tree diagrams Red indicates higher tier only - Knowledge Organiser - Mathematics

Venn diagrams

Out of 50 people surveyed:

30 have a brother
25 have a sister
8 have both a brother and sister



a) Complete the Venn diagram

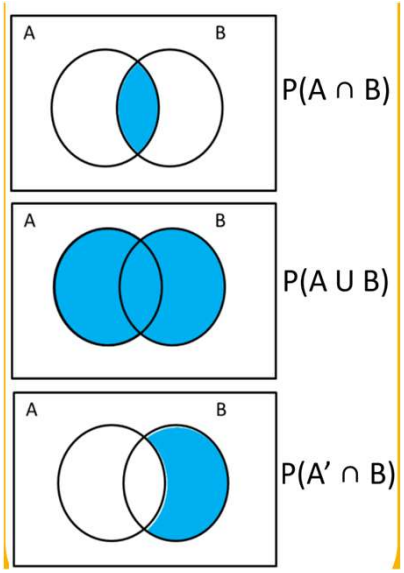
b) Calculate:

i) $P(A \cap B) = \frac{8}{50}$ ii) $P(A \cup B) = \frac{47}{50}$ iii) $P(B') = \frac{20}{50}$

iv) The probability that a person with a sister, does not have a brother.

$= \frac{8}{25}$

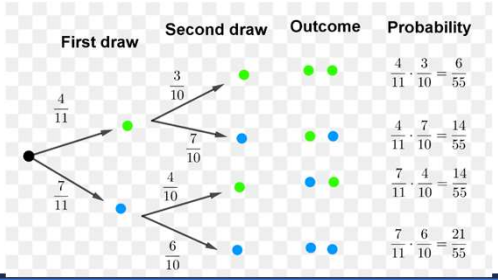
Set notation



Dependent events

The outcome of a **previous event does influence/affect the outcome of a second event.**

An example of dependent events could be not replacing a counter in a bag after picking it.
'Without replacement'



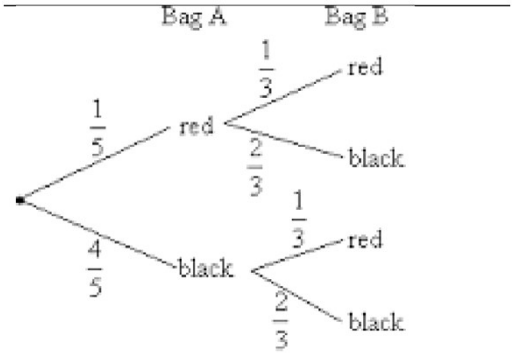
Independent events

Tree diagrams show **all the possible outcomes** of an event and calculate their probabilities.

All branches must add up to 1 when adding downwards.
This is because the **probability of something not happening** is **1 minus the probability that it does happen**.

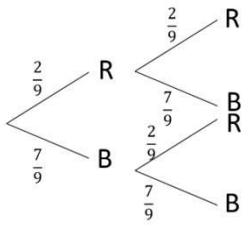
Multiply going **across** a tree diagram.

Add going **down** a tree diagram.



Examples of Independent events and Dependant events

There are red and blue counters in a bag.
The probability that a red counter is chosen is $\frac{2}{9}$.
A counter is chosen and **replaced**, then a second counter is chosen.
Draw a tree diagram and calculate the probability that two counters of the same colour are chosen.

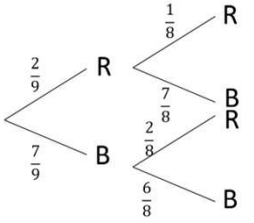


Prob of two reds: $\frac{2}{9} \times \frac{2}{9} = \frac{4}{81}$

Prob of two blues : $\frac{7}{9} \times \frac{7}{9} = \frac{49}{81}$

Prob of same colours: $\frac{4}{81} + \frac{49}{81} = \frac{53}{81}$

There are red and blue counters in a bag.
The probability that a red counter is chosen is $\frac{2}{9}$.
A counter is chosen and **not replaced**, then a second counter is chosen.
Draw a tree diagram and calculate the probability that two counters of the same colour are chosen.



Prob of two reds: $\frac{2}{9} \times \frac{1}{8} = \frac{2}{72}$

Prob of two blues : $\frac{7}{9} \times \frac{6}{8} = \frac{42}{72}$

Prob of same colours: $\frac{2}{72} + \frac{42}{72} = \frac{44}{72}$

Sparx 7: Measure & Compound measures-

Red indicates higher

Knowledge Organiser - Mathematics

Converting weights

1 tonne = 1000kg
1000g = 1kg
$\frac{1}{10}$kg = 0.1kg = 100g

$\frac{1}{4}$kg = 0.25kg = 250g
$\frac{1}{2}$kg = 0.5kg = 500g
$\frac{3}{4}$kg = 0.75 = 750g

÷ 1000 ÷ 1000
grams (g) kilograms (kg) tonnes (t)
× 1000 × 1000

Converting capacity

1000ml = 1l
$\frac{1}{10}$l = 0.1l = 100ml
$\frac{1}{4}$l = 0.25l = 250ml

$\frac{1}{2}$l = 0.5l = 500ml
$\frac{3}{4}$l = 0.75l = 750ml
$\frac{1}{100}$l = 0.01l = 10ml

÷ 1000
millilitre (ml) litres (l)
× 1000

Converting time

Minute 1 minute = 60 seconds
Hour 1 hour = 60 minutes
Day 1 day = 24 hours
Week 1 week = 7 days
Year 1 year = 12 months = 52 weeks = 365 days

Imperial to metric units

metric (new)	imperial (old)
2.5 centimetres	1 inch
1 kilogram	2.2 pounds
4.5 litres	1 gallon

÷ 2.5
centimetres inches
× 2.5

÷ 4.5
litres gallons
× 4.5

÷ 2.2
kilograms pounds
× 2.2

Converting units of length

1000m = 1km
100cm = 1m
10mm = 1cm

$\frac{1}{2}$m = 0.5m = 50cm
$\frac{1}{4}$m = 0.25m = 25cm

$\frac{3}{4}$m = 0.75m = 75cm
$\frac{1}{10}$m = 0.01m = 10cm

÷ 10 ÷ 100 ÷ 1000
millimetres (mm) centimetres (cm) metres (m) kilometres (km)
× 10 × 100 × 1000

Compound measures

Compound Measures

Don't forget your formula triangles.

Speed: D / S T

Density: M / D V

Pressure: F / P A

Copper has a density of 8.92g/cm^3. Silver has a density of 10.49g/cm^3. 20cm^3 of copper and 5cm^3 of silver are mixed to form a new metal.

a) What is the density of the new metal?

Step 1 – Calculate the mass of each metal — Mass = Density x Volume

Copper = 8.92 x 20 = 178.4g

Silver = 10.49 x 5 = 52.45g

Step 2 – Add the masses together — 178.4 + 52.45 = 230.85g

Step 3 – Use the formula for density using your new mass and volume — Density = M÷V = 230.85 ÷ 25 = 9.234g/cm^3

b) Convert your answer into kg/m^3

g → kg = ÷ 1000

cm^3 → m^3 = x 1,000,000

Overall, we multiply by 1000

= 9.234 kg/m^3